

CLAIMS

1. An optical semiconductor device comprising:
an active region; and
a p-doped cladding region disposed on one side of the active region;
wherein an electron-reflecting barrier is provided on the p-side of the active region for reflecting both Γ -electrons and X-electrons, the electron-reflecting barrier providing a greater potential barrier to Γ -electrons than the p-doped cladding region.
2. A device according to claim 1, wherein the electron-reflecting barrier comprises a first electron-reflecting layer for reflecting Γ -electrons and a second electron-reflecting layer for reflecting X-electrons.
3. A device according to claim 1, wherein at least one of the electron-reflecting layers is a strained layer.
4. A device according to claim 3, wherein one of the electron-reflecting layers is in a state of compressive strain and the other of the electron-reflecting layers is in a state of tensile strain.

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5. A device according to claim 1, wherein the device is a light-emitting diode.

6. A device according to claim 1, wherein the device is a laser device.

7. A device according to claim 6, wherein the device is a separate confinement heterostructure laser device comprising an optical guiding region, the active region being disposed within the optical guiding region.

8. A device according to claim 2, wherein the layer for reflecting Γ -electrons is disposed between the optical guiding region and the layer for reflecting X-electrons.

9. A device according to claim 8, wherein the Γ -conduction band of the optical guiding region is substantially degenerate with the X-conduction band of the layer for reflecting Γ -electrons.

10. A device according to claim 2, wherein the layer for reflecting Γ -electrons is disposed between the layer for reflecting X-electrons and the p-doped cladding region.

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5 11. A device according to claim 1, wherein the electron-reflecting barrier comprises a plurality of first electron-reflecting layers for reflecting Γ -electrons and a plurality of second electron-reflecting layers for reflecting X-electrons.

10 12. A device according to claim 11, wherein the electron-reflecting barrier is a superlattice structure.

15 13. A device according to claim 2, wherein the device is fabricated in the (Al,Ga,In)P system, the layer for reflecting Γ -electrons is made from a material selected from the group consisting of AlP and GaP, and the layer for reflecting X-electrons is made from InP.

20 14. A device according to claim 11, wherein the device is fabricated in the (Al,Ga,In)P system, each layer for reflecting Γ -electrons is made of a material selected from the group consisting of AlP and GaP, and each layer for reflecting X-electrons is made from InP.

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15. A device according to claim 9, wherein the layer for reflecting Γ -electrons is AlP and the optical guiding region is $(\text{Al}_{0.3}\text{Ga}_{0.7})_{0.52}\text{In}_{0.48}\text{P}$.

5 16. A device according to claim 13, wherein the thickness of each of the electron-reflecting layers is 16Å or less.

17. A device according to claim 1, wherein at least one of the electron-reflecting layers is p-doped.

10 18. A device according to claim 13, wherein the first electron-reflecting layer contains indium.

15 19. A device according to claim 7, wherein the electron-reflecting barrier is disposed between the optical guiding region and the p-doped cladding region.

20. An optical semiconductor device comprising:
an optical guiding region;

20 an active region having at least one energy well, said active region being disposed in said optical guiding region; and

n-doped and p-doped cladding regions disposed on opposite sides of the optical guiding region;

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wherein an electron-reflecting layer for reflecting Γ -electrons is provided at the p-side of the active region; and

wherein the Γ -conduction band of the optical guiding region is substantially degenerate with the X-conduction band of the electron-reflecting layer.

21. A device according to claim 20, wherein the optical guiding region is formed of $(\text{Al}_{0.3}\text{Ga}_{0.7})_{0.52}\text{In}_{0.48}\text{P}$, and the electron-reflecting layer is formed of AlP.

22. A device according to claim 20, wherein the electron-reflecting layer is p-doped.

23. A device according to claim 20, wherein the electron-reflecting layer is disposed between the optical guiding region and the p-doped cladding region.

24. A device according to claim 20, wherein the device is a separate confinement heterostructure laser device.

25. (Added) An optical semiconductor device comprising:
an active region; and
a p-doped cladding region disposed on one side of the

active region,

wherein at least one electron-reflecting layer is provided on a p-side of the active region of reflecting Γ -electrons.

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26. (Added) A device according to claim 25, wherein the at least one electron-reflecting layer is fabricated in a phosphorus system.

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27. (Added) A device according to claim 26, wherein the at least one electron-reflecting layer is provided on the p-side of the active region for reflecting both Γ -electrons and X-electrons, the at least one electron-reflecting layer providing a greater potential barrier to Γ -electrons than the p-doped cladding region.

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28. (Added) A device according to claim 26, wherein said active region has at least one potential well, and is disposed in an optical guiding region,

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n-doped and p-doped cladding regions are disposed on opposite sides of the optical guiding region, and

the Γ -conduction band of the optical guiding region is substantially degenerate with the X-conduction band of the at least one electron-reflecting layer.